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# AUTOMATIC CLASSIFICATION OF SKIN LESIONS USING GEOMETRICAL MEASUREMENTS OF ADAPTIVE NEIGHBORHOODS AND LOCAL BINARY PATTERNS

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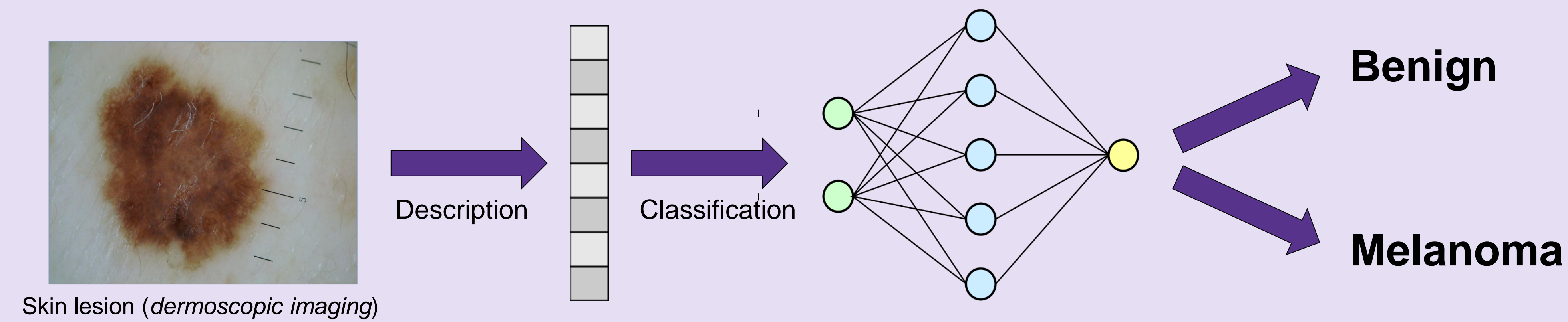
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## Context

### Computer-Aided Diagnosis



## Methods

### General Adaptive Neighborhoods (GANs)

The **GAN** of a point  $x$  is a **spatial neighborhood** whose size and shape is adapted to the local features of the image.

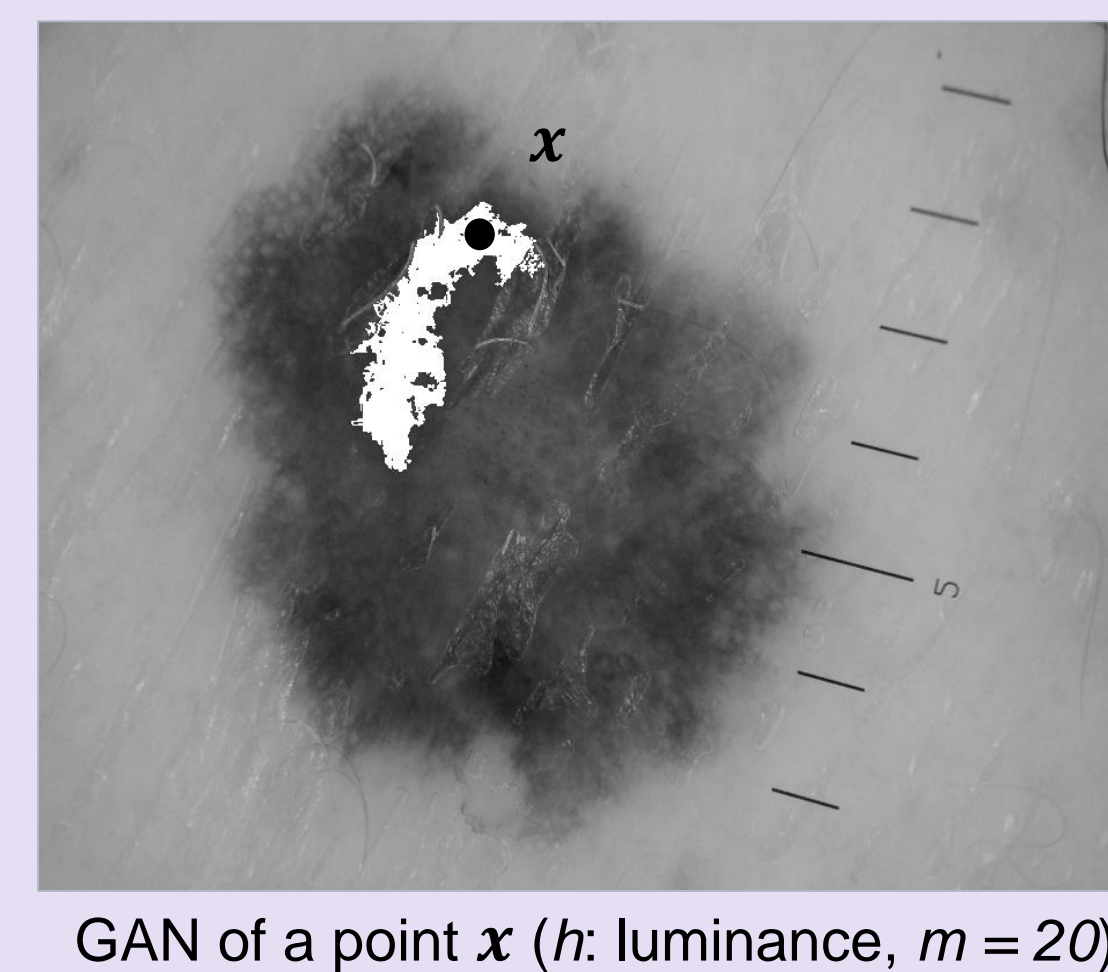
#### Definition

- The intensities of its points are close to that of the seed point according to a selected criterion (e.g., luminance, contrast...).
- The GAN is a **path connected** set.

$$V_m^h(x) = C_{\{y \in D: |h(y) - h(x)| \leq m\}}(x)$$

where:

- $D$ : Spatial support, ( $D \subseteq \mathbb{R}^2$ )
- $h$ : Criterion mapping, ( $h: D \rightarrow \mathbb{R}$ )
- $m$ : Tolerance homogeneity
- $C_X(x)$ : Path connected component of  $X$  containing  $x$



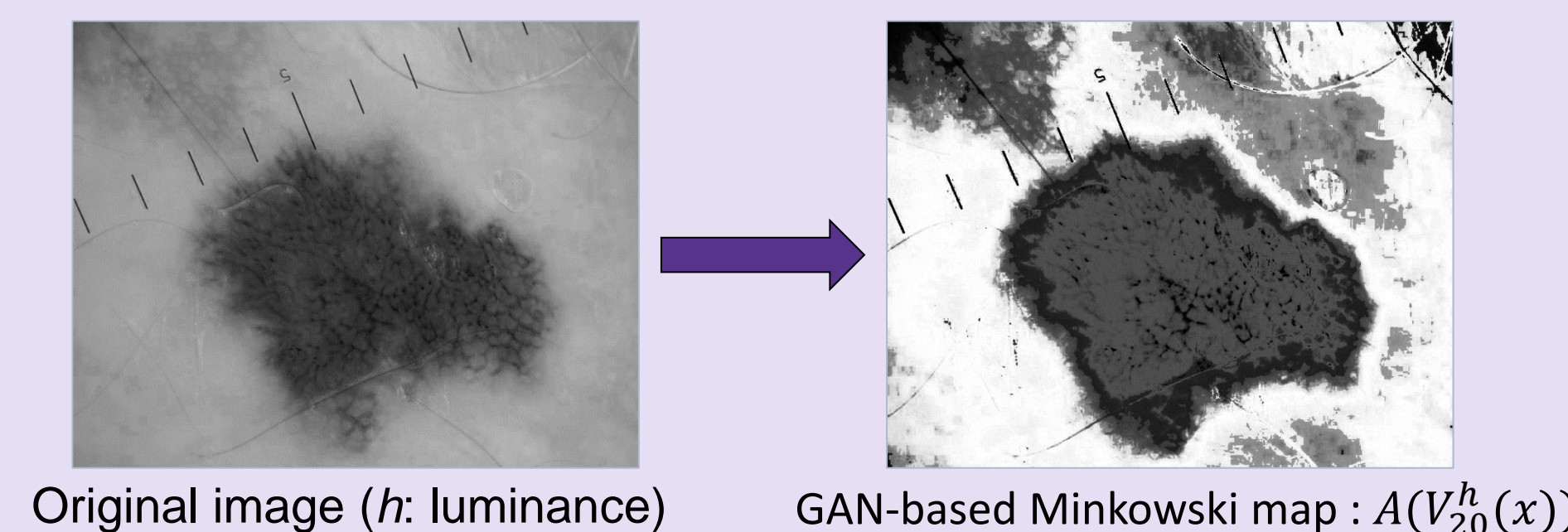
### GAN-based Minkowski Map (Local Characterization)

#### Definition

$$\mu_m^h(x) = \mu(V_m^h(x))$$

where  $\mu$  is a **Minkowski functional**:

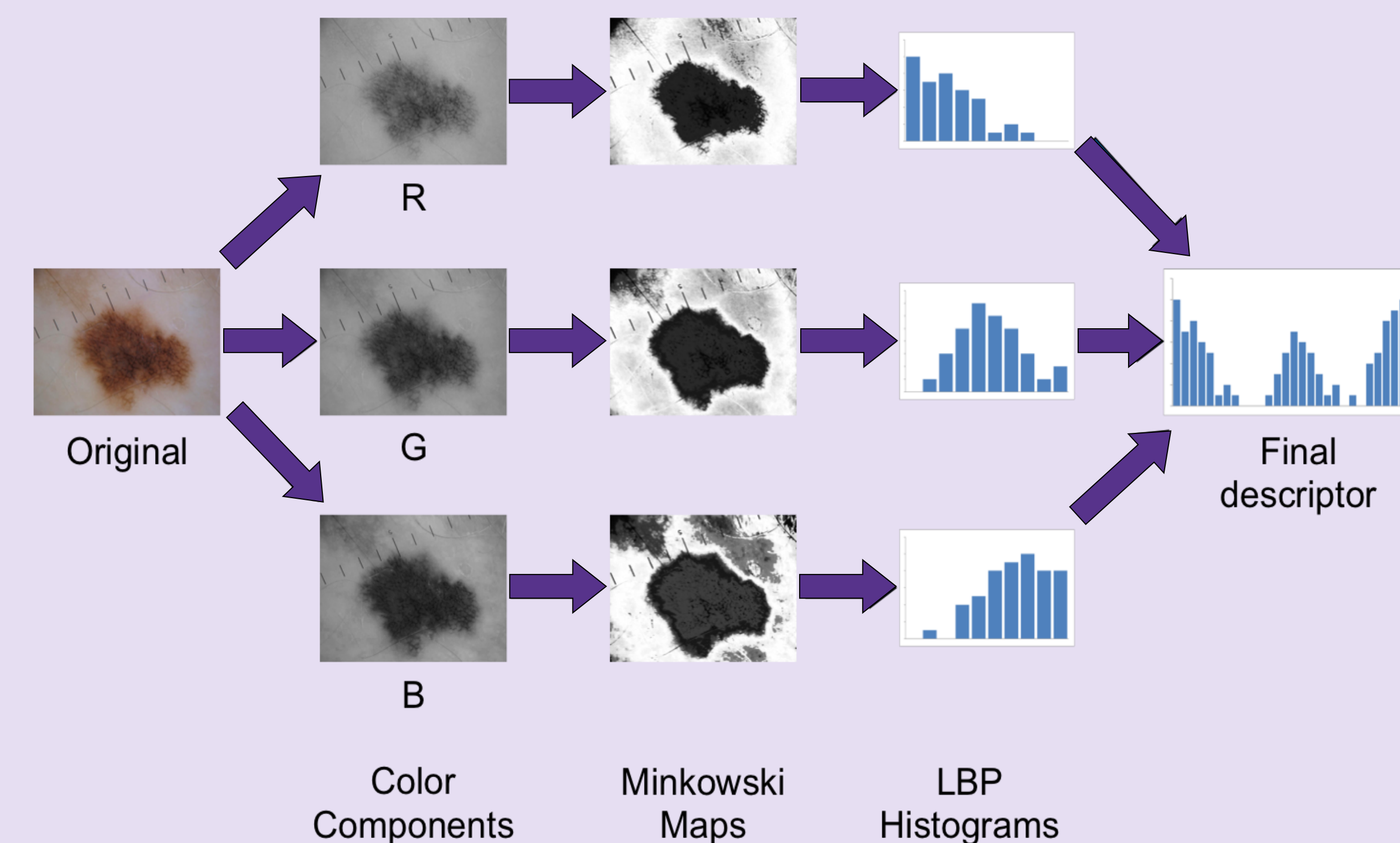
- Area ( $A$ )
- Perimeter ( $P$ )
- Euler Number ( $\chi$ )



### Image Description (Skin Lesion Features)

The **final image descriptor** is built in two steps:

- The GAN-based Minkowski map (with  $\mu = A$ ) of the color components R, G and B of the original image is computed.
- The **Local Binary Pattern** (LBP<sub>P,R</sub>) operator of each of these maps is computed, and the three histograms are concatenated.



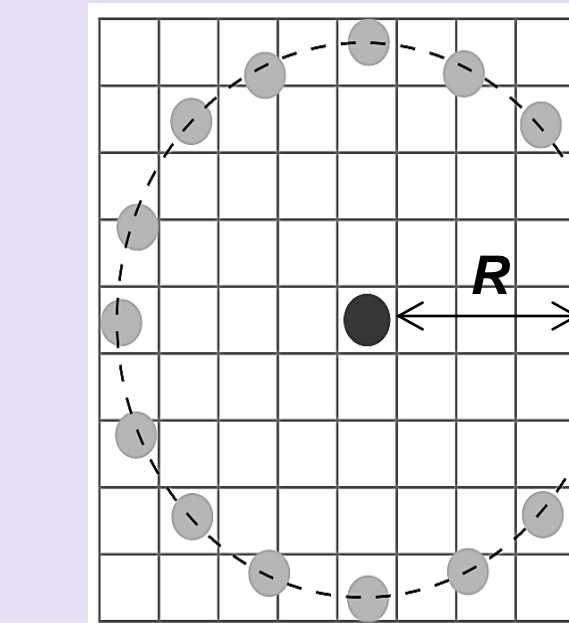
## Experiments

### Dataset

**1097 dermoscopic images** of pigmented skin lesions: 88 of them histopathology confirmed melanomas.

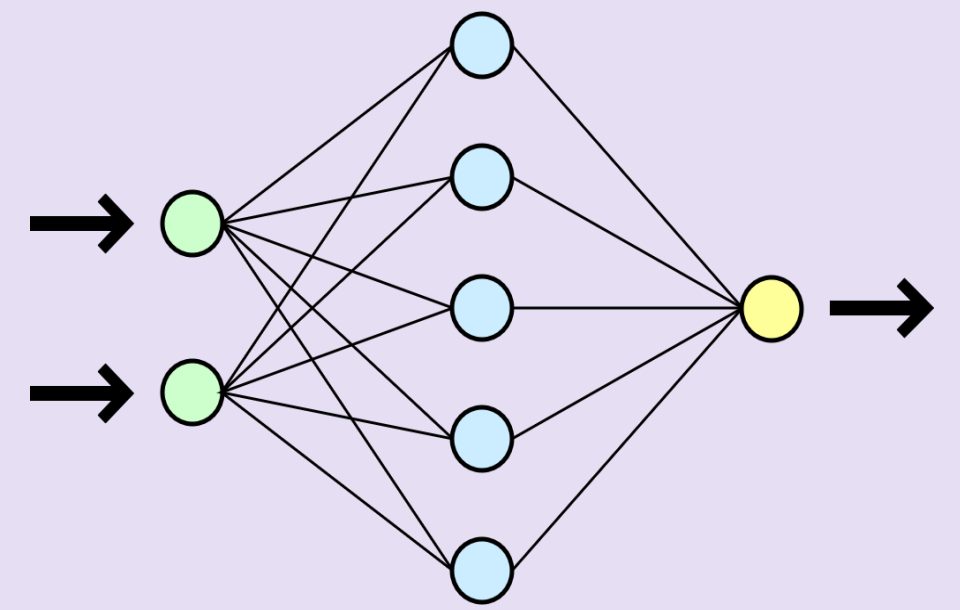
### Descriptor parameters

- GAN-based Minkowski maps
  - $m = 20$
  - $\mu = A$  (area)
- LBP<sub>P,R</sub>
  - $P$  fixed to 8
  - $R$  varying from 1 to 6



### Classification

- Feed-forward neural network
- One hidden layer
- Sigmoid transfer function
- 10-fold cross validation



## Results

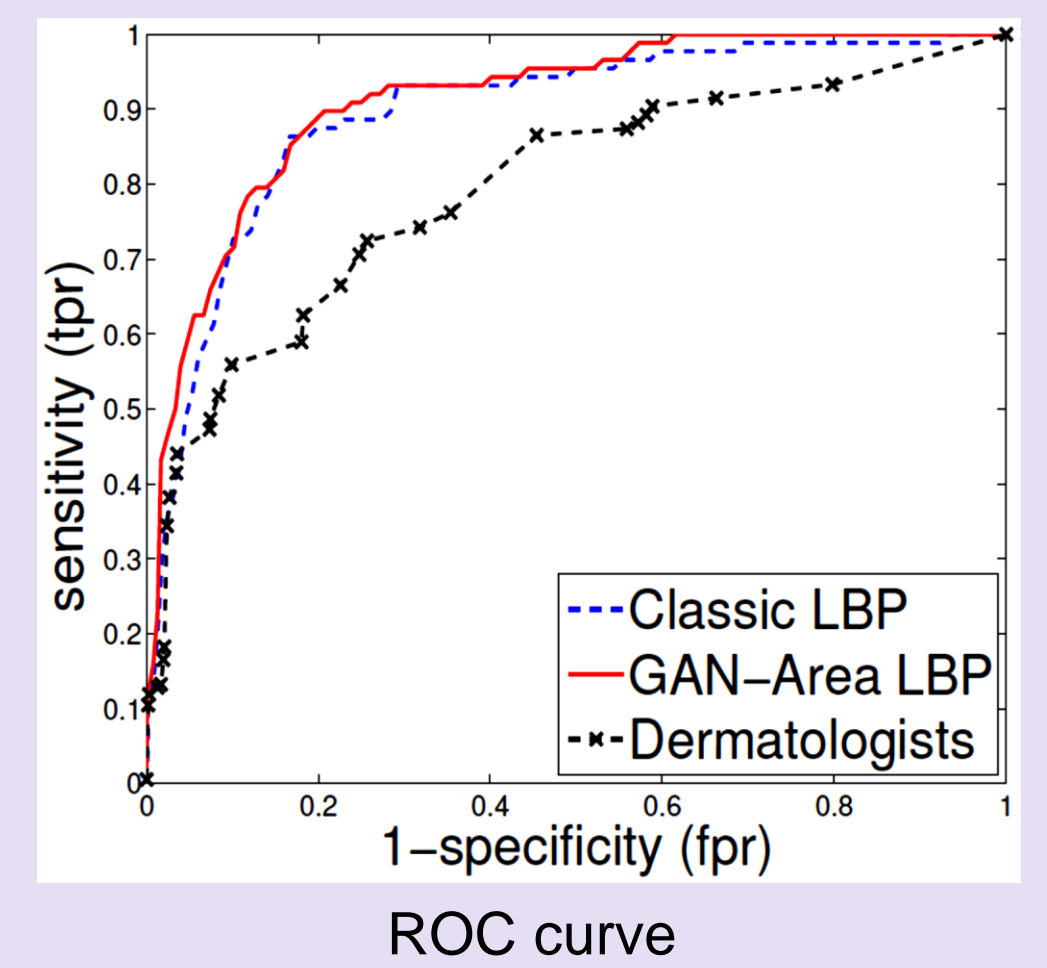
- Area under ROC curve.
- Different neurons in hidden layer and training cycles.
- Comparison with classical LBP.

R	Num. neurons	Num. cycles	AUC
1	10	300	0.8726
2	7	300	<b>0.8948</b>
3	7	400	0.8934
4	5	500	0.8946
5	7	400	0.8895
6	10	400	0.8898

Classical LBP

R	Num. neurons	Num. cycles	AUC
1	10	500	0.8547
2	10	500	0.8780
3	10	500	0.8934
4	7	300	0.8976
5	10	500	0.9052
6	10	500	<b>0.9115</b>

The proposed method: GAN-Area LBP



## Conclusion and Perspectives

### Conclusion

- Classification of color images of naevi as benign lesions or melanoma.
- Descriptor built upon LBP and local geometrical features.
- Performance evaluated and compared with the classical LBP and the dermatologists' predictions.
- AUC: 0.792 (Dermatologists); 0.8948 (Classical LBP); **0.9115** (Proposed method).

### Perspectives

- Assess other GAN-based geometrical and/or morphometrical features.
- Automatic selection of relevant features.